



Seguro Pesticide Personal Protective Equipment (PPE)

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What we will cover today

- ⇒ Background and Context
- ⇒ Previous Group's Prior Work
- ⇒ Goals and Approach
- ⇒ Challenges and Obstacles
- ⇒ Results
- ⇒ Goals Validation
- ⇒ Conclusions and Future Directions

Background and Context

- ➔ The Problem: Pesticide exposure and poisoning of farm-workers and their families in California's Central Valley

- ➔ Social
 - Primary and secondary exposure
 - Diseases: allergies, skin irritations, cancers, birth defects, etc.
 - Children are especially susceptible

- ➔ Historical
 - Lax regulation
 - Little incentive for companies to provide Personal Protective Equipment (PPE)
 - Undocumented, poorly educated farm-workers
 - Lack political and economic empowerment



Background and Context



⇒ Cultural

- Most are immigrants—majority from Mexico
- Language/communication barriers—unaware of what is available
- Machismo and image consciousness—impede adoption of protective technologies

⇒ Technical/Economic Barriers

- Poverty = low purchasing power
- High percentage of income used to self-supply PPE
- High financial risk to invest in unknown, untested technology

⇒ Connection to Sustainability

- Meeting the needs of current and future generations
 - Conserving human capital—mitigating pesticide poisoning of the target population
 - Addressing inequity

Previous Group's Prior Work

➔ Preliminary User Needs Assessment

- Community workshop
- Farm-worker interviews



First Protective Suit Prototype



⇒ Design based on the preliminary user needs assessment

Second Protective Suit Prototype

- ⇒ Design was simplified
- ⇒ Stuff sack and pull straps included
- ⇒ Zippers on cuffs for easy access
- ⇒ Market Analysis



Challenges

⇒ Discrepancies in data from user needs assessment

- Results from previous work suggested that community members wanted a protective suit and a sustainable manufacturing cooperative
- In depth research revealed that some community members did not like/would not wear the suit, and felt disconnected from the graduate students (cultural, language, education)

⇒ Poor documentation and communication from past groups

- Protective suit prototypes were lost—needed to have the suit remade
- Members of past groups were unresponsive/unavailable
- Sparse documentation of previous work
- External collaborating research group that conducted pesticide/farm-worker studies was unavailable to meet this semester

Initial Goals and Approach



⇒ Literature Reviews

- Goal: To generate background information for this project
- Information: Sensor technologies and suit materials

⇒ Developing Contacts

⇒ Sustainable Manufacturing Cooperative

- Goal: Develop a feasible plan for a sustainable manufacturing cooperative
- Information: Initiation, management hierarchy, maintenance, financial considerations
- Methods: Background literature searches, interviews with local cooperatives

Initial Goals and Approach

⇒ Farm-worker User Needs Assessment

- Goals:
 - Determine fundamental needs and genuine desires for pesticide protection among farm-workers
 - Address routes of exposure that are not mitigated by the suit
- Information:
 - Working conditions
 - Current methods of protection and desired technologies
 - Feedback on current prototype and manufacturing co-op plan
- Methods: Interviews with farm-workers at Earlimart, CA



Obstacles

⇒ Farm-worker User Needs Assessment: Earlimart, CA

■ Logistics

- Scheduling difficulties
- Misperceptions with Berkeley students due to past interactions—uncooperative and unexcited
- Misinformation and communication issues with the local contact at the field site

■ Sampling

- Small sample size
- All interviewees were aware of pesticides and its dangers
- However, they still provided relevant information about the surrounding community
- Findings from the user needs assessment differed from previous work



Revised Project Goals

⇒ Minimum

- Cross-comparison user needs studies
- Development of design criteria for the future improvement of the protective suit, sensors, and other PPE
- Organization of past and current work for the project

⇒ Optimal

- Generation of new protective suit and PPE designs that incorporate design criteria
- Field studies/trialability of new PPE designs

Revised Approach

⇒ Cross-Comparison User Needs Assessment

- Goal: To determine if user needs vary among farming communities
- Information:
 - Working conditions and current methods of protection
 - Pesticide concerns
 - Design criteria for all PPE and sensors
- Methods: Revision of previous interview questions, interviews with local farm-workers, purchasing of applicable PPE for preliminary trialability
- Communities:
 - Napa, CA
 - Coalinga, CA

⇒ Human Subjects Approval

- Goal: To gain approval for human trials with new design iterations of the protective suit, sensor technologies, and other PPE
- Methods: Submission of paperwork



Revised Approach

⇒ Design Criteria for PPE and Sensors

- Goal: To develop appropriate guidelines for future design iterations of PPE and sensors
- Methods: Analysis of interview data and product searches
- PPE:
 - Sensor
 - Accessories: hand, face, and eye protection
 - Protective suit

⇒ Organization of Past and Current Work

- Information:
 - Electronic and hardcopy notes, presentations, proposals
 - List of contacts



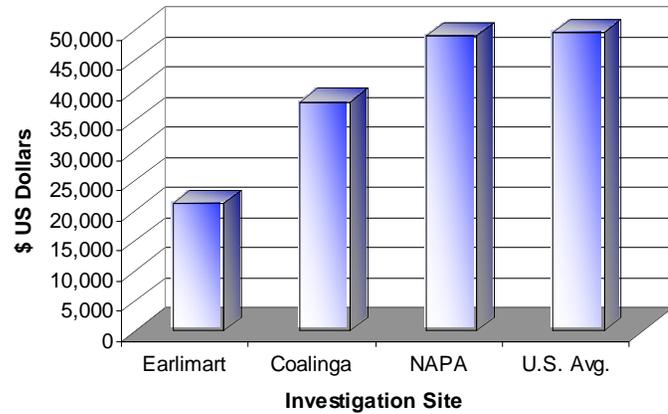
Obstacles

- ⇒ Cross-comparison user needs assessment: Napa, CA and Coalinga, CA
 - Data collection
 - Challenging to design interview questions that were open-ended and unbiased
 - Interviewing a vulnerable population—could not gather any demographic data and needed to make them feel comfortable
 - Having enough translators for recording/transcribing data
 - Analyzing and categorizing our qualitative data
 - Logistics
 - Reimbursement procedures and paperwork associated with giving farm-workers and coordinators compensation
 - Due to the long reimbursement process, our Earlimart, CA contact refused to schedule another visit until after payment

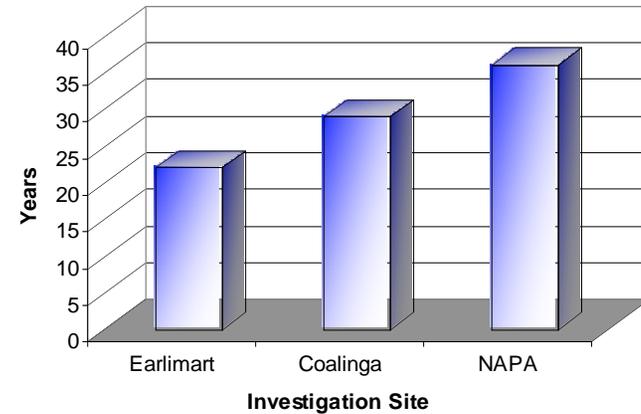
- ⇒ Human subjects approval and PPE manufacturing
 - Timeline
 - Lengthy processing time and prototyping precluded trials of purchased PPE

Results: Site Demographics

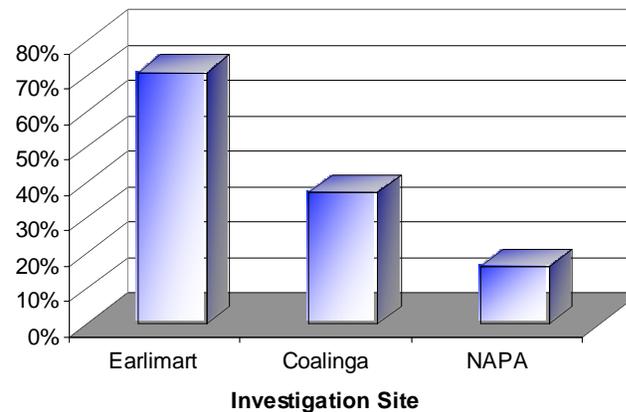
Avg. Household Income (All Races)



Median Age (All Races)



Population of Latinos



<http://www.nuninetguide.com/>

<http://www.idcide.com>

Results: Site Background

	Earlimart, CA	Coalinga, CA	Napa, CA
# Yrs. Working (Group Range)	8-20yrs.	3-20yrs.	3-40yrs.
Work Schedule	5-6 full days (sunrise to sunset)	5-6 days (9-12 hrs)	6-7 days (8-15hrs)
Types of Crops	Grapes	Lettuce, cotton, onions, tomatoes, pomegranates	Grapes
Tasks	Harvesting, pruning, pesticide/fertilizer spraying, planting	Cleaning ground cover, harvesting, pesticide spraying	Picking, pruning, pesticide spraying, cleaning, planting, putting up wire
Climate	Low and high temps. (Max~115°F)	Low and high temps. (Max~110-115°F)	Low and high temperatures; night shifts; work stops in extreme heat
Major Pesticide Issues	Men get sick more often than women	Children are considerably more sensitive/vulnerable than adults to pesticides	Contamination occurs when neighboring fields are sprayed
Vulnerable Body Parts	Entire face: eyes, nose, and mouth	Entire face: eyes, nose, and mouth; feet	Entire face: eyes, nose, and mouth; hands
Current PPE	Safety glasses, street clothing, handkerchiefs, hat, gloves	2-3 handkerchiefs, safety glasses, boots, long sleeve shirts, eye drops	Company provided coveralls (maintained by the company), disposable masks, boots, chemical gloves, safety glasses, street clothing, 4 handkerchiefs
Health Issues From Pesticides	Blisters, skin and eye irritation, allergies, headaches, stomachaches, nausea	Birth defects, "Valley Fever", bumps/hives, diminished hearing abilities, soreness in legs and bones, and blood poisoning	Cancer, diabetes, birth defects, diminished vision, headaches, dizziness, skin discoloration, blisters, allergies, sterility, irritation of the eyes and respiratory tract
Routes of Exposure to Children/Protective Measures	Clothing (hugging), vehicles, pesticide residuals in the washing machine	Clothing (hugging), vehicles	Clothing (hugging), drift

Results: Sensors and Eye Protection

	Earlimart, CA	Coalinga, CA	Napa, CA
<i>Sensors</i>			
Desired Information from Sensors	Type and amount of pesticides in environment and on the body	Type and amount of pesticides; reagents that cause "Valley Fever"	Type and amount of pesticides
Desired Location	Homes, community, and on the torso	Entrances to community and homes, freeway, fields, and on the wrists	Freeway, fields, homes, and on the wrists
Desired Form-Factor	Wrist-watch, clock, thermostat	Large for community sensors, small for personal sensors (wrist-watch)	Large for community sensors, fire alarms/CO sizes for homes, stickers for personal sensors, wrist-watch, thermostat, clock
Desired Price	\$10	\$10-\$30	\$10-\$20
<i>Eye Protection</i>			
Current Eye Protection Limitations	Do not sufficiently protect from dust and pesticides	Do not adequately protect the side of the eyes from dust, no tint, foggy	Do not sufficiently protect from dust and pesticides
Desired Qualities	Doesn't trap pesticides, anti-fog, breathable, comfortable; spraying mechanism to clean out eyes	Transition lenses (not too dark), face wrapping, anti-fog	Full coverage of eyes (from pesticides and sweat), anti-fog, head strap, lightweight
Desired Price	\$15	\$10-\$25	\$15

Results: Suit and Hand Protection

	Earlimart, CA	Coalinga, CA	Napa, CA
<i>Hand Protection</i>			
Current Hand Protection Limitations	Too many types of gloves, not water-resistant	Not durable, penetrable by dust, rubber gloves are too sweaty, not sufficient for cold weather	Cuffs are too short
Desired Qualities	Single glove, waterproof, thin, flexible for dexterity, low porosity, durable, scratch resistant, warm but breathable, gripping surface	Durability, larger variety of sizes to accommodate men and women	Durability, flexible, longer cuffs, breathable material for hot weather, warm material for cold weather
Desired Price	\$10-\$15	\$2-\$5	\$10
<i>Clothing</i>			
Current Clothing Limitations	Hanging straps or hooks on current protective suit prototype can be very dangerous, desirable for cold weather, but not for hot weather	Clothing is not tailored type of work; boots are too heavy; the suit is desirable for cold weather, but not for hot weather	Hanging straps or hooks can be very dangerous, suit is more desirable for cold weather, but not for hot weather
Reasons for Purchasing	Protection and comfort, some thought a protective suit is more important than gloves or eye protection, others thought the opposite	Weather and pesticide protection	Weather and pesticide protection
Desired Qualities	Light colors, elastic cuffs, extra long zippers and mesh for ventilation, non-stick material, no pull straps	Boots should be lightweight, soft (no digging into their calves), flexible, and high; lightweight suit	Full body suit, zippers along torso, multiple sizes to accommodate all body types, lighter color, sealable openings, hoods, shoe covers, attachable accessories; form fitting, stretchy, flexible material for women, stuff bag, longer leg zippers, more pockets
Desired Price	\$8-\$30	\$10-\$70	\$20-\$50

Results: Face, Vehicle Protection

	Earlimart, CA	Coalinga, CA	Napa, CA
<i>Face Protection</i>			
Current Face Protection Limitations	4 handkerchiefs are too troublesome, masks are not breathable	Putting on multiple handkerchiefs is troublesome, eyes are exposed	Not completely sealed, masks are not breathable
Desired Qualities	Face mask, thicker than current handkerchiefs, breathable, covers everything above the shoulders except for the eyes	One piece face cover, various sizes to accommodate all body types	Anti-fog face shield, transition lenses, visor, suit integration
Desired Price	\$5-\$10	\$5	\$10
<i>Vehicle</i>			
Desired Qualities	Secondary storage for soiled clothing in the vehicle	Secondary storage for soiled clothing in the vehicle	Seat covers
Desired Price	\$8-\$30	\$15	--
<i>General Concerns</i>	Not enough time or resources to run a manufacturing co-op	Interested in face masks, pesticide drift is an important issue	Education program for farm-workers with seminars/speakers and small groups

Design Recommendations

- ⇒ Interviewees evaluate purchased PPE and current protective suit prototype
- ⇒ All suggested PPE and the current protective suit prototype did not meet all the farm-workers needs
- ⇒ Therefore, new PPE and protective suit designs need to be generated
 - Due to the feedback here are some suggested products:
 - ◆ Design/materials research is currently being done to reduce the costs while ensuring the same effectiveness

**Velotique Waterproof/Breathable
SealSkinz Gloves - \$50**



**ESS Glasses & Goggles ESS
Military Advancer V12 Goggles
- \$89**



Goals Validation

⇒ Minimum

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⇒ Optimal

- Generation of new protective suit and PPE designs that incorporate design criteria
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Currently in Progress.....

Conclusions

- ⇒ Lessons Learned: Design of PPE
 - Significance of understanding the fundamental user needs and desires of the target population
 - Importance of feedback on prototype designs and off-the-shelf PPE
 - Tailoring of designs for specific groups

- ⇒ Lessons Learned: Field Work
 - Overcoming challenges and obstacles
 - Importance of communication and organization
 - Development of appropriate interview questions

- ⇒ Overall Project Deliverables
 - Comprehensive design criteria for future PPE iterations
 - Compilation of prior and current work for future efforts

Future Suggested Directions



- ➔ New PPE Design Iterations Based on Design Criteria
- ➔ Human Subjects Approval for Field/Trialability Studies
- ➔ Education
- ➔ PPE Manufacturing and Distribution Infrastructure and Political Mandates

Thank you!

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